NREL
NATIONAL RENEWABLE ENERGY LABORATORY

ENERGY SYSTEMS INTEGRATION

ESI optimizes the design and performance of electrical, thermal, fuel, and water pathways at all scales.

PARTNERSHIPS

NREL + DUKE ENERGY

NREL is partnering with Duke Energy to better understand the operational differences between standard inverters and smart inverters, which can provide features to support the grid during disturbances and routine operations. This project focuses on the potential opportunities to use smart inverters to support voltage regulation for electric power distribution systems and how to incorporate such capabilities in the software tools used by the utility for grid operations. This project uniquely combines what-if simulations using the same distribution management system (DMS) software Duke Energy uses for daily operations with the ESIF's ability to connect actual inverters and utility control equipment to software models through power hardware-in-the-loop testing.

R&D STRATEGY

Duke Energy is providing extensive data for a real-world rural distribution circuit that includes a 5-megawatt solar photovoltaic (PV) system located 2.1 miles from the substation. The provided data includes the technical details of the network along with one year of power, voltage, and current measurements taken every minute from the substation and PV system. NREL and its partner GE Grid Solutions (formerly Alstom Grid) are then simulating future operations with Duke Energy's DMS and comparing and contrasting three classes of operating modes: with a conventional inverter, with a smart inverter providing local power control, and with smart inverters coordinated by the centralized DMS to optimize voltage control using a combination of existing utility resources and advanced PV inverters.

IMPACT

Adding solar PV systems and other forms of distributed generation to existing distribution systems can introduce much faster power dynamics, potentially changing how the utility regulates distribution voltage and possibly requiring a need to make adjustments to support power flowing back toward the substation. These faster dynamics could cycle traditional voltage control devices much more frequently, causing them to fail prematurely. Instead, this research could enlist the help of advanced inverters to better control the voltage on power distribution lines, allowing the grid to operate more efficiently.

Working in the ESIF's collaboration room, NREL engineers Mike Simpson (left) and Adarsh Nagarajan study the topology of a feeder within a power distribution grid. *Photo by Dennis Schroeder, NREL 34487*

Partner with NREL at the ESIF

User facility access to the ESIF is awarded through the review and approval of user proposals, depending on the scientific merit, suitability of the user facilities, and the appropriateness of the work to DOE objectives, and includes a signed user agreement for the facility.

For more information, please visit:
www.nrel.gov/esi/working_with.html
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The Energy Systems Integration Facility (ESIF) at the National Renewable Energy Laboratory (NREL) provides the R&D capabilities needed for private industry, academia, government, and public entities to collaborate on utility-scale solutions for integrating renewable energy and other efficiency technologies into our energy systems.

To learn more about the ESIF, visit: ***www.nrel.gov/esif***.

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